

32. (Amended) The method as claimed in claim 22, wherein the spacer layer comprises a plurality of layers of perforated tape, an aggregate of the plurality of layers of perforated tape producing the height to prevent electrostatically induced damage to the MEMS wafer.

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33. (Amended) The method as claimed in claim 22, wherein the spacer layer comprises a plurality of layers of perforated tape, an aggregate of the plurality of layers of perforated tape producing the height to prevent damage to the MEMS structures due to the wafer cover coming into physical contact with the MEMS wafer and to prevent electrostatically induced damage to the MEMS wafer.

125. (Amended) The wafer as claimed in claim 124, wherein said layer of dicing tape has a UV releasable adhesive.

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126. (Amended) The wafer as claimed in claim 124, wherein said layer of dicing tape is heat shrinkable.

127. (Amended) The wafer as claimed in claim 124, wherein said layer of dicing tape has a UV releasable adhesive and the layer of dicing tape is heat shrinkable.

REMARKS

Claims 1-156 are pending in the present application.

The Examiner has alleged that the presently pending claims are directed to 20 separate patentably distinct species of the claimed invention as allegedly set forth in pages 5-9 of the originally filed specification. This assertion by the Examiner and follow-on election of species requirement is respectfully traversed.

Pages 5-9 set forth, in summary form, the various aspects of the present invention that are disclosed in the originally filed specification. Pages 5-9 do not set forth all the various aspects of the present invention that are claimed in the pending claims of the above-identified application. Accordingly, it is improper to base an election of species requirement upon what is disclosed in

the originally filed specification because an election of species requirement must be directed to the claimed invention or inventions as specifically set forth by the pending claims.

Furthermore, the Examiner has failed to provide a *prima facie* case that the alleged embodiments have a species relationship. For example, the Examiner apparently alleges that a laminated MEMS wafer is a species a method of protecting a wafer during dicing. The Applicants respectfully assert that these two examples do not have a species relationship.

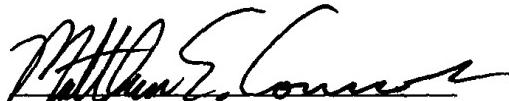
However, assuming that the Examiner can actually demonstrate a species relationship between these various aspects of the present invention as set forth in pages 5-9 of the originally filed specification, the Applicants respectfully submit that claims 1-68, 99-111, 115-123, and 128-141 read upon the 12th aspect of the present invention as set forth in pages 5-9 of the originally filed specification, and claims 69-98, 112-114, 124-127, and 142-156 read upon the 14th aspect of the present invention as set forth in pages 5-9 of the originally filed specification. As noted before, the Applicants respectfully maintain that the 12th aspect of the present invention as set forth in pages 5-9 of the originally filed specification and the 14th aspect of the present invention as set forth in pages 5-9 of the originally filed specification fail to have any species relationship therebetween.

In view of the above discussion, the Applicants, elect, with traverse, claims 1-68, 99-111, 115-123, and 128-141, which read upon the 12th aspect of the present invention as set forth in pages 5-9 of the originally filed specification.

Accordingly, in view of all the reasons set forth above, the Examiner is respectfully requested to reconsider and withdraw this election of species requirement. Also, an early indication of allowability is earnestly solicited.

Attached to this Response is a marked-up copy of all the above-presented amended claims. Also, attached to this Response is a clean set of pages 16, 20, and 23 of the specification incorporating the amendments presented above.

Respectfully submitted,



Matthew E. Connors
Registration No. 33,298
Samuels, Gauthier & Stevens
225 Franklin Street, Suite 3300
Boston, Massachusetts 02110
Telephone: (617) 426-9180
Extension 112

MEC/MJN/mjn
Attachments

structures so as to provide clearance for surface MEMS structures. The spacer layer **101** and tape **103** may be combined and then cut to produce areas corresponding to the MEMS structures on the MEMS wafer, cut by a laser to produce areas corresponding to the MEMS structures on the MEMS wafer, or punched to produce areas corresponding to the MEMS structures on the MEMS wafer. The spacer layer **101** and tape **103** may also be pre-combined and cut or punched to produce areas corresponding to the MEMS structures on the MEMS wafer; or before being combined, the spacer layer **101** and tape **103** may also be pre-cut or pre-punched to produce areas corresponding to the MEMS structures on the MEMS wafer. The spacer layer **101** and tape **103** may be combined using pressure to promote adhesion. If a non-UV reliant adhesive material is used, the holes or openings in the spacer layer may be laser cut when a UV or IR resistive material is used.

Figure 20 illustrates the bonding of an aligned spacer layer **101** with adhesive layer **103** with a MEMS wafer **13** having MEMS structures **5** and openings **105** corresponding to areas of the MEMS structures **5**. The aligned spacer layer **101** may also be bonded to the MEMS wafer **13** through mechanical means or through bonds produced by applying the aligned spacer layer **101** to the MEMS wafer **13** with a predetermined amount of pressure. The MEMS wafer **13** has formed thereon MEMS structures **5**. In a typical MEMS wafer **13**, there could hundreds to thousands of MEMS structure sites, each containing MEMS structures **5**.

After the aligned spacer layer **101** with adhesive layer **103** is bonded is a MEMS wafer **13** having MEMS structures **5** and openings **105** corresponding to areas of the MEMS structures **5**, a wafer cap **110** is bonded to the spacer layer **101**, as illustrated in Figure 21. The wafer cap **110** may be a non-perforated cover tape. The non-perforated cover tape and/or spacer layer **101** and adhesive layer **103** comprising a plurality of layers of perforated tape may comprise static dissipative material.

The wafer cap **110** encloses the MEMS structures **5** to protect them from damage. The wafer cap **110** may include an adhesive medium. The adhesive medium of the wafer cap **110** may be an ultraviolet light releasable medium, a heat releasable medium, a combination of an ultraviolet light and heat releasable medium, a thermoplastic organic material, an ultraviolet light sensitive organic material, or a solder material. The wafer cap **110** may also be bonded to the MEMS wafer **13** through mechanical means or through bonds produced by applying the wafer cap **110** to the MEMS wafer **13** with a predetermined amount of pressure.

waffer 13 and between MEMS structure sites 150 to produce cuts or saw kerfs 109. The dicing may be realized by using a saw, using a laser, or using scribing and breaking.

In Figure 30, the cut dicing cover tape 140 is exposed to an UV radiation source 125 that produces UV radiation 126. The UV radiation 126 is sufficient to break the bond or release the adhesive between dicing cover tape 140 and the MEMS wafer 13. The cut dicing cover tape 141 is then heated, via conduction, convection, or by radiation 128 to produce individual releasable cut dicing cover tape pieces 141, as shown in Figure 31. The application of heat 128 causes the cut dicing cover tape pieces 141 to curl up and away from the MEMS wafer 13 in this embodiment. The cut dicing cover tape pieces 141 are removed together, as illustrated in Figure 32, with a dicing cover tape removal layer 145. It is noted that the dicing cover tape 140 may be a non-heat shrinkable and/or non-UV releasable tape so that the dicing cover tape 140 could be individually removed without use of UV radiation or heat.

Figure 33 shows dies 200 ready for removal from the spacer layer 250 and wafer cap 270, which can be accomplished a number of ways. Also possible, but not shown in the figures, is the sawing of individually capped dies, accomplished by simultaneously sawing through the backside cover tape 140 and the spacer 250 and wafer cap 270. This would be accomplished via the addition of a transfer tape layer to the wafer cap 270 prior to sawing, and subsequent removal of the die 13, spacer 250, and wafer cap 270 from the transfer tape layer. The wafer cap 270 and spacer layer 250 may be removed from an individual die before the die is placed in a package or after it is placed in a package.

Figures 34-41 illustrate another, preferred, process of protecting a MEMS die during a separation and handling process according to the concepts of the present invention. As illustrated in Figure 34, a wafer 13 includes a plurality of MEMS structure sites 150 with corresponding through holes 130 on a backside of the wafer 13. The through holes 130 are holes 25 in the back of the wafer 13 that are formed by etching through the wafer 13 to the front side where the MEMS structure sites 150 are located.

The wafer 13 is capped in Figure 35 with a spacer layer 250 and a wafer cap 270 on a front side or patterned side of the wafer 13, a front side having the MEMS structure sites 150 located thereon. The spacer layer 250 having openings or holes 105 corresponding with each of the MEMS structure sites 150. The spacer layer 250 may include an adhesive layer.

The spacer layer 250 may comprise a tape having adhesive on two sides and a flexible film or a flexible film with an adhesive medium on one side. The flexible film may be transmissive to UV radiation and may be about 10 to 20 mils thick. The spacer layer 250 may

In Figure 37, the capped wafer 13 is diced from a backside of the wafer 13 to produce a plurality of capped MEMS dies using a dicing saw 107 with a dicing saw blade 108 rotating in a direction 106. The dicing occurs through the dicing cover tape 140 and wafer 13 and between MEMS structure sites 150 to produce cuts or saw kerfs 109. The dicing may be realized by 5 using a saw, using a laser, or using scribing and breaking.

In Figure 38, a second layer of tape 160; preferably, a standard, non-UV curable adhesive tape; is added to the backside of the diced wafer 13. The second tape, or transfer tape 160 is applied over the diced the dicing cover tape 140. This transfer tape 160 is used in transferring the diced wafer 13, as a whole unit, to another station or stations in the process, such as a station 10 performing die inspection.

In Figure 39, the wafer cap 270 and spacer layer 250 are exposed to UV radiation 126 from a UV source 125. This exposure by UV radiation 126 enables the wafer cap 270 and spacer layer 250 to be peeled away from the wafer 13 as individual pieces or layers if each layer used a 15 UV releasable adhesive or as a single unit if only the spacer layer 250 used a UV releasable adhesive for bonding to the wafer 13. By removing the wafer cap 270 and spacer layer 250, the MEMS structure sites 150 become exposed, ready for inspection, testing, or actual use.

In Figure 40, the cut dicing cover tape 140 and transfer tape 160 are exposed to an UV radiation source 125 that produces UV radiation 126. In the preferred embodiment, the UV radiation 126 is sufficient to break the bond or release the adhesive between dicing cover tape 140 and the wafer 13 because in the preferred embodiment, the transfer tape 160 uses a non-UV 20 releasable adhesive to bond to the dicing cover tape 140.

As shown in Figure 41, individual dies from the cut wafer 13 are lifted off the dicing cover tape 140 and transfer tape 190 with die sorting equipment. In a preferred embodiment, a standard die ejection needle assembly 195 is used to lift off the individual dies of the wafer 13 25 from the dicing cover tape 140 and transfer tape 190.

Figure 42 illustrates a preferred process for protecting a wafer during dicing. As shown in Figure 42, at step S1, layers of tape S1A and S1C are mounted or bonded to a carrier ring S1B. These layers of tape S1A and S1C produce an aggregate of layers of tape to produce a height so as to prevent electrostatically induced damage to the MEMS structures on the wafer 30 S3B and/or to prevent a wafer cap S4A from deflecting in such a manner to come in contact with the MEMS structures on the wafer S3B.

In step S2, the layers of tape S1A and S1C are punched S2A and S1C are so as to produce recesses within the layered tape corresponding to the MEMS structure sites S2B. It is

ATTACHMENT A
Marked-up Copy of Amended Claims

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layer of dicing tape is heat shrinkable.

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